

**What is claimed is:**

1. A time simulation method of determining service availability of a network with single failures having a plurality of nodes and a plurality of links, the method including steps of:
  - (a) selecting a link to fail;
  - (b) performing a simulated link failure on the selected link;
  - (c) selecting a connection between a network source and sink node pair; and
  - (d) determining and summing the unavailability and availability of the connection under the simulated link failure condition
2. The method of claim 1 further comprising steps of:
  - (e) repeating the step c) until all or a predetermined number of connections have been selected; and
  - (f) repeating the steps a) and b) until a simulated link failure has been performed on all links or until the summed unavailability and availability has been determined to converge, whichever is earlier.
3. The time simulation method of determining service availability of a network with multiple failures having a plurality of nodes and a plurality of links, the method comprising steps of:
  - a) initializing all counters;
  - b) initiating a simulated network failure process;
  - c) maintaining failure repair and unavailability timing;
  - d) selecting a link to which the network failure applies
  - e) initiating recovery, repair and unavailability timing;
  - f) selecting a connection between a network source and a sink node pair; and
  - g) determining and summing the unavailability and availability of the connection under the simulated link failure condition.

4. The method of claim 3 further comprising steps of:

h) repeating the step f) until a predetermined number of connections have been selected; and

5 i) repeating the steps b) to e) until a simulated link failure has been performed on all links or until the summed unavailability and availability has been determined to converge, whichever is earlier.

5. The time simulation method according to claims 3 or 4 further comprising a step of:

10 averaging the service availability across all connections to generate the service availability of the network

6. The time simulation method according to claim 4 wherein: all the above steps are performed in response to clock increments, which proportionately  
15 correspond to actual times.

7 The time simulation method according to claims 3 or 4, wherein the network has corresponding nodes and links, the links having attributes in relation to their characteristics with respect to simulated failures, recovery and repair  
20 processes, the method further comprising a step of:

randomly selecting a link based on the attributes of the links.

8. The time simulation method according to claims 3 or 4, wherein the network has corresponding nodes and links, the links having attributes in relation  
25 to their characteristics with respect to simulated failures, recovery and repair processes, wherein the attributes are in relation to their distance, time-to-failure parameter, and time-to-recover/repair.

9. A time simulation apparatus for determining service availability of a  
30 network comprising a plurality of nodes, links and connections, each plurality

having various attributes such as relating to failure, recovery and repair mechanisms, the apparatus comprising:

an instance selecting mechanism for selecting one instance from each of the plurality of nodes, links and connections based on the attributes;

5 a failure/repair module for performing a simulated failure and repair on the selected instances as appropriate;

a connection selecting mechanism for selecting a connection between source and sink nodes, and

10 an arithmetic mechanism for calculating the availability of the selected connection.

10. The time simulation apparatus according to claim 9, further comprising:

15 an averaging module for averaging the availability of connection for all possible connections in the network to generate the overall service availability of the network.

11. The time simulation apparatus according to claim 9, further comprising a clock for generating clock increments calibrated to correspond to a specific real time interval.

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12. The time simulation apparatus according to claim 9, wherein the network has corresponding nodes and links, the links have attributes in relation to their characteristics with respect to simulated failures, recovery and repair processes.

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13. The time simulation apparatus according to claim 12, the apparatus further comprising a mechanism for randomly selecting a link based on the attributes of the links.

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14. The time simulation apparatus according to claim 13, wherein the attributes are in relation to their distance.